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ABSTRACT

A study was conducted at Sacramento City College to determine the effect of "College Success" (CS), an extended orientation class, on students' academic performance and persistence. The study included three groups of students: 116 students enrolled in CS, 104 students who attended a 4-hour New Student Orientation (NSO), and 84 students who attended a last-minute, 1-hour information session (IS). Students from each group were matched by age, sex, and recommended reading and writing placement. When comparing the academic performance and persistence of CS students with that of either of the other groups, it was found that CS students: (1) completed an average of 2.76 more semester units of college credit; (2) earned a grade point average that was .71 grade points higher; and (3) had proportionately lower dropout rates (i.e., 8.62% compared to 18.27% for NSO students and 21.29% for IS students). Based on study findings, it was concluded that there was sufficient evidence at the 5% level to indicate that taking the CS course did result in significant positive differences in academic performance and persistence of matched pairs of students. No statistically significant differences between the two non-treatment groups were observed on any of the measures of academic performance or persistence. Student data summary and statistical formulas are appended. (Author/EJV)

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STUDENT PERSISTENCE AND ACHIEVEMENT: AN EVALUATION OF THE EFFECTS OF AN EXTENDED ORIENTATION COURSE

A RESEARCH STUDY CONDUCTED BY
DR. EDWIN H. STUPKA
SACRAMENTO CITY COLLEGE

Sponsored In Part By a Grant From
The Northern California Cooperative Institutional Research Group
March 1986

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This paper is dedicated to former Sacramento City College student, Victor Sneed, whose untimely death is felt by all who knew and loved him. His creativity, energy and enthusiasm, along with his computer expertise, were valued assets in earlier College Success research efforts that laid the groundwork for this report.

Table of Contents

	Page
Abstract	1
Acknowledgements	i
Context of the Problem	1
Statement of the Problem	2
Limitations of the Study	3
Review of the Literature	4
Study Design	7
Data Collection and Matching Procedures	8
The Results	9
Conclusions of the Study	11
Appendix A - Summary of Group Data	12
Appendix B - Statistical Formulas	15
Bibliography	20

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ABSTRACT

The purpose of this study was to determine if there is evidence to support the claim that an extended orientation class called "College Success" (CS) has a positive effect on academic performance and persistence.

Students from three groups were involved in this study.

(1) those enrolled in "College Success" (CS)

(2) those who attended a 4 hour New Student Orientation (NSO)

(3) those who attended a last-minute 1 hour information session (IS)

Students from each group were matched to students from each of the other two groups on four criteria: (1) age, (2) sex, (3) recommended reading placement, (4) recommended writing placements.

When comparing the academic performance and persistence of CS students with that of either of the other two groups, CS students:

1. Completed an average of 2.76 more semester units of college credit.

2. Earned a G.P.A. .71 grade points higher.

3. Had a proportionately lower college drop-out rate.

   (a) 8.62% to 18.27% when compared to NSO students.

   (b) 8.62% to 21.29% when compared to IS students.

Using the given data, there is sufficient evidence at the 5% level to conclude that taking the College Success course did result in significant positive differences in the academic performance and persistence of matched pairs of students as measured by the number of semester units of college credit earned, grade point average, and college drop-out rate. No statistatically significant differences between the two non-treatment groups were observed on any of the measures of academic performance or persistence.

Context of the Problem

Early in 1986, Dr. Joshua Smith, newly installed Chancellor of the California Community Colleges, stated that the California Community Colleges are in the midst of an "ambiguous situation" created by the continuing debate surrounding the redefinition of their role and function and by the realities of changing and uncertain funding patterns. At the same time they are being challenged to improve the quality of education.

Three central issues have emerged:

1. Reexamination of the open-door admission policy.

2. Student retention strategies.

3. Quality education.

These issues focus attention on the need for the development and implementation of more effective ways of supporting student achievement.

Probably at no time during the history of the California Community College movement have more changes occurred in such a short time. In the last five years, some of the colleges have operated with virtually no cash reserves. Others have made such dramatic cost-savings changes as to seriously errode the educational quality of their institutions.

One specific, but subtle example has been the broad shift in staffing patterns, which have resulted in counselor staffing ratios as high as 950 to 1.

Because of such high counselor/student ratios, few California Community Colleges have explored the extended orientation concept beyond the offering of a handful of courses taught by counselors. Instead, many community colleges have taken the view that supporting student success should be the sole responsibility of the classroom teacher. This report will, hopefully, create a re-examination of the role of counselors in supporting student success.

This research project was funded in part by a grant from the Northern California Cooperative Institutional Research Group (NORCAL). A major outcome of this project will be to provide research data linking extended orientation to academic achievement and persistence.

Statement of the Problem

The purpose of this study was to determine if there is evidence to support the claim that "College Success", a semester-long orientation course, has a positive effect on academic performance and persistence. The academic progress of three different groups of students was studied:

1. Those enrolled in a semester-long orientation course called "College Success" (CS).

2. Those who attended a four-hour new student orientation (NSO) program.

3. Those who attended a last-minute one-hour information session immediately before registration (IS).

The following measures of academic success and persistence were examined and compared:

1. Number of units of college credit completed.

2. Grade point average.

3. College drop-out rate.

The independent variable was the extended orientation course called, "College Success". The control variables were age, sex, recommended reading placement and recommended writing placement.

It was expected that, when comparing the academic achievement and persistence of matched-pairs of students, those who were enrolled in CS would demonstrate (1) the completion of more semester units of college credit, (2) a higher grade point average and (3) a lower college dropout rate.

Limitations of the Study

1. Self-Selection Bias

Any study that includes students who are self-selected into the treatment process, has a built-in bias. This researcher acknowledges the self-selection bias as one of the limitations of this study. The argument is that students who have a certain awareness, predisposition or motivation are the one's that are most likely to self-select into the treatment process. Thus, there is always the danger that the group experiencing the treatment may be brighter, or more motivated and mature than the groups receiving no treatment. If important variables are not controlled, the outcome of the treatment may be a function of initial differences between the groups, rather than of the treatment being evaluated.

The following steps were taken to limit the effects of this bias:

A. A quasi-experimental research design was used.

B. The dependent variables were identified as

   (1) number of semester units of credit earned

   (2) grade point average

   (3) dropout rate

C. The control variables judged to be most likely to have an effect on the dependent variables were identified as

   (1) age

   (2) sex

   (3) recommended reading placement

   (4) recommended writing placement

D. The internal validity of this study was established by using the matched-pair technique to identify pairs of students from the three selection pools who were matched on all four control variables.

2. Absence of Historical Data

In an open-door, open-admission college, where people are not denied admission because of the lack of standard test scores or high school transcripts, little historical data is available. The only test scores related to academic achievement were the Stanford Test of Academic Skills (TASK). These scores provide a standard yardstick that is used as a tool in placing students. Although used as a proxy for academic ability, the lack of other academically-revealing information presents a serious research limitation.

3. Exclusion of High Risk Students

Certain high risk students were systematically excluded from all three selection pools by the design of this study and the limitations of data collection and matching.

4. No Information On Length of Treatment and Its Long-Term Effect

Researchers have been cautious in reporting that a specific treatment, over a limited period of time can indeed, have a permanent impact on student achievement.

Review of the Literature

The idea of having a special orientation-to-college program for first-time students is not new. Boston University began such a program before the turn of the century. Since then, most colleges and universities have developed some kind of program for new students. Such programs vary in length from a few hours to a few days. All of these programs are attempts to provide new students with information that will enhance their chance of success in college.

Over the last five years, there has been a growing interest in providing students with more assistance as they enter college. "Increasing Student Competence and Success", a four-year study sponsored by ACT National Center for the Advancement of Educational Practices, studied student persistence at forty-four public and private colleges and universities. This study recommended six strategies to improve student success. Their first recommendation addresses the importance of a term-long orientation course.

> *"Probably the single most important move an institution can make to increase student persistence to graduation is to ensure that students receive the guidance they need at the beginning of the journey through college to graduation. This early guidance can also assist them in acquiring the competence, through the formal general education curriculum, that they will need to complete their courses of study and function effectively after graduation.*
>
> *At its best, this guidance system should include the following features:*

New student orientation should begin well before students arrive on campus and should continue as a formal course during the first term on campus."

The National Task Force on Redefining the Associate Degree (Koltai, 1984), made similar recommendations urging colleges to "move from a climate of student self-advisement to a carefully planned process."

Kangas (1985) reported the results of a California Community College survey of matriculation practices. Almost one-half of the colleges reporting (46%) had no orientation as part of their admissions process. In addition, Kangas found that many colleges providing orientations are not doing so for all new students. He concluded:

"Orientations require a philosophical commitment to their value, a great deal of management time to coordinate and to organize, plus a substantial cost in hourly time, effort and money. Any or all of these variables can impede the implementation of orientations, especially since classified and management positions were often hit hardest with post-Proposition 13 cutbacks."

The need for and importance of a more structured and supportive learning experience for beginning college students was also cited by Anderson (1984).

Maisey-Ireland (1985) expressed the outcome of orientation in consumer terms. As students become more skilled and knowledgable, they begin to take education more seriously and trial-and-error behavior is reduced. As the quest for "full value" for the time and effort invested continues, the ownership in ones' education increases and the focus on educational quality is likely to increase.

Rieves (1978) makes the case that helping minority college students develop self-control, is an important way of contributing to their academic success. He argues that this can best be done through carefully planned and executed support programs at the beginning of their college journey.

Upcraft (1984) sees the growing need for extended orientation programs as being related to both societal and individual factors. He states that if a college or university understands those factors that enable students to succeed, it can develop an orientation program that compensates for student deficiencies, enhances student strengths and provides maximum opportunities for student achievement.

Gordon and Frites (1984), in a comprehensive report on the freshman seminar course presented a global view covering such diverse issues as history and related research; course goals and objectives; course instructor, format and credit; grading; content; course evaluation; and related political issues. Their concluding statement reads in part:

"Traditional students generally entered college after a preparatory high school curriculum: they were prepared for college academically and anticipated the college experience

in traditional ways. Many of todays' students are older, come from different vocational backgrounds, attend part time, or are not as well prepared academically as students in the past. The "new" students need more initial contact and guidance if they are to survive. A freshman seminar course is an effective method of providing this structure and support."

Gardner and Jewler (1985) have developed an extended orientation course called, "University 101", which has become a model for dozens of other institutions. The annual "National Conference on The Freshman Year Experience," hosted by their university, has become an important market place for the exchange of ideas and information related to orientation.

A formal evaluation of "University 101" has been conducted since the beginning. Retention rates of freshmen have been a principal focus in evaluating the success of this program. A research summary, revised in January 1984, compared participants with non-participants. It reports that, "In general, freshmen who participated in University 101 had a higher probability of returning for the sophomore year."

Other writers have also linked extended orientation with student retention. Noel and Beal (1978) identified institutions that had exemplary student retention programs. Virtually every retention program listed orientation or extended orientation programs as a major part of their retention efforts.

After initiating a required orientation course, DeRemer (1984) in an unpublished report, cited an 18% reduction in the dropout rate in one specific program at the University of North Dakota. Ellis (1980) reported a 27% reduction in the number of first-quarter dropouts after a mandatory orientation course was initiated at a midwestern proprietary college.

Forest (1982) reported that a career exploration course taken the first term gave support and direction to new students and contributed to greater competence and learning and higher retention rates. Prola and Stern (1984) noted improvement in academic performance and persistence, (although not at a level of significance) among students enrolled in a semester-long freshman orientation course. Kovac (1980), reported that students completing a two-hour new student orientation program completed more units of college credit and earned a higher grade point average.

In summary, this review of the literature found broad support for using a term-long course as a vehicle to provide assistance, support and direction to both new and returning students. The importance and value of initiating a carefully planned and well executed course is well documented. In addition, there is growing evidence such a course is directly linked to increased academic achievement and persistence and reduced student decisions based on trial and error.

As shown in the review of the literature, the transition to college is a complex process that few students are totally prepared for. It is theorized that students who participate in a structured, supportive semester-long

orientation course will:

1. Begin to clarify why they are in college, identify personal and work values, and establish realistic career and life goals.

2. Gain a better understanding of the occupational implications of their educational choices.

3. Benefit from having experienced a structured, supportive learning environment for an entire semester.

4. Develop an understanding of the rules and regulations that affect them including information about academic programs and standards, majors, transfer and graduation requirements.

Study Design

A nonequivalent control group design was used in this study. This quasi-experimental design is used when intact groups of students are studied. In this commonly found circumstance, the experimenter has no control in the assignment of students to conditions. Internal validity was established by using the matched pair technique.

The independent variable was the extended orientation course C.S. The control variables were (1) age, (2) sex, (3) recommended reading placement and (4) recommended writing placement. The dependent variables were (1) GPA, (2) number of units of college credit completed and (3) dropout rate.

Subjects

Four different groups of students were identified for possible inclusion in this study. After applying the selection criteria one group was eliminated from the study because of insufficient numbers. The three groups included in this study were:

(1) Those enrolled in College Success (CS).

(2) Those who attended a three hour New Student Orientation (NSO).

(3) Those who attended a last-minute one hour information session (IS).

A more detailed description of these groups is found in Appendix "A".

Students who met the following selection criteria were included in the selection pools used for matching pairs of students:

1. Completed the Stanford Test of Academic Skills (TASK).

2. Were offically enrolled at the beginning of the fourth week of instruction.

3. Completed one or more courses during the Spring 1985 semester with a grade of A, B, C, D, F or credit.

Group One consisted of all students enrolled in an extended orientation course called College Success. The one-hundred sixteen (116) students from this group who met the aforementioned criteria are referred to as Group One (CS) selection pool from which matched-pairs of students were selected.

Group Two (NSO) consisted of students who completed the New Student Orientation (NSO) program. At this college, as an incentive to encourage students to attend NSO, those who complete NSO are given priority registration. Space is limited and available on a first-come, first-serve basis. Typically, about half of all new students complete NSO and are given priority registration. For the Spring 1985 semester, approximately seven-hundred (700) students completed NSO. For this study, a more easily managed population of students was created by random selection. From this random sample one-hundred four (104) students met the selection criteria and were included in the Group Two (NSO) selection pool.

Group Three (IS) consisted of students who were too late in following through on the admissions process to be included in NSO. They did, however, elect to attend an hour-long last-minute information session before registering in classes. Since only one-hundred forty-two (142) people attended these sessions, they all were included in the initial step of the formation of the Group Three (IS) selection pool. From this group of students eighty-four (84) met the selection criteria and were included in the Group Three (IS) selection pool.

So few students from the fourth group qualified for inclusion in this study that the entire population was dropped from the study.

Data Collection and Matching Procedures

A 3" x 5" data card was made for each student in the three selection pools. The completed data card included the students' name, social security number, age, sex, recommended reading placement, recommended writing placement, number of units of college credit completed this semester, and semester grade point average.

To begin the matching procedure, the 3" x 5" cards in each of the three selection pools were organized by sex, then reading and writing placement and finally, by age. Because the Group Three selection pool had the least number of students, an attempt was made to match every student in that selection pool, using the following procedures:

1. A 3" x 5" card was randomly selected from the Group Three (IS) selection pool. Using the four control variables an attempt was made to match this student with one from either of the other two selection pools.

2. If a match was found an attempt was made to match these two students with a student from the third selection pool. If a match was found in the third selection pool the three 3" x 5" cards were clipped together and were included in the study.

3. If no match was found in either of the two selection pools the unmatched cards were eliminated from the matched pairs.

This matching procedure resulted in 37 matched triads in which each student in the triad was matched with a student from each of the other two groups.

The Results

Using the given data, there is sufficient evidence at the 5% level to conclude that College Success does result in significant positive differences in the academic performance and persistence of matched groups of students. No statistically significant differences between the other two groups of students was observed on any of the measures of academic performance or persistence.

The following charts show comparisons between the different groups of matched pairs. The statistical formulas used can be found in Appendix B.

Statistical Data Comparing:
College Success (CS) Students
with
New Student Orientation (NSO) Students

		N	Dropped out / Completed	$\bar{x}$	s	p*	zc = 1.65 at 5% level 1 tailed test	z score
GPA	CS	37	—	2.56	1.0760	—	1.65	1.82
	NSO	37	—	2.07	1.2608			
Units Completed	CS	37	—	9.15	4.6650	—	1.65	2.32
	NSO	37	—	6.51	5.0915			
Dropout Rate	CS	116		—	—	8.62%	-1.65	-2.11
	NSO	104		—	—	18.27%		

This chart shows that CS students outperformed NSO students on all three measures of academic achievement and persistence. These differences were significant the the 5% level.

Statistical Data Comparing:
College Success (CS) Students
with
Information Session (IS) Students

		N	Dropped out / Completed	$\bar{x}$	s	p*	zc = 1.65 at 5% level 1 tailed test	z score
GPA	CS	37	—	2.56	1.076	—	1.65	3.44
	IS	37	—	1.64	1.2258			
Units Completed	CS	37	—	9.15	4.6650	—	1.65	2.53
	IS	37	—	6.27	5.0971			
Dropout Rate	CS	116	10 / 106	—	—	8.62%	-1.65	-2.97
	IS	84	18 / 66	—	—	21.29%		

IS students did not perform as well as CS students as indicated by this chart. In each of the 3 measures the greatest differences found in this study occured in the comparison of these two groups.

Statistical Data Comparing:
New Student Orientation (NSO) Students
with
Information Session (IS) Students

		N	Dropped out / Completed	$\bar{x}$	s	p*	zc = 1.65 at 5% level 1 tailed test	z score
GPA	NSO	37	—	2.07	1.2608	—	1.65	1.47 reject
	IS	37	—	1.64	1.2258			
Units Completed	NSO	37	—	6.51	5.0915	—	1.65	1.48 reject
	IS	37	—	6.27	5.0971			
Dropout Rate	NSO	104	19 / 85	—	—	18.27%	-1.65	-0.05 reject
	IS	84	18 / 66	—	—	21.29%		

Although this chart indicates the NSO students consistantly outperformed IS students these differences were not significant at the 5% level.

Conclusion

The current re-evaluation of the role and mission of the Community Colleges in California has focused attention on the need to develop more effective ways of supporting academic achievement and persistence. The findings of this research project offers encouraging results on the effectiveness of extended orientation in supporting student success. These findings are consistant with the growing volume of professional literature on the importance of providing more structure and direction for students as they begin their college work. Hopefully, this study will stimulate additional experimentation and research in this rapidly developing area.

EXHIBIT A

SUMMARY OF STUDENT DATA BY GROUP

Summary of Group Data

Group One

Students enrolled in College Success.

1.	College Success enrollment at the beginning of the fourth week of instruction		140
2.	The number of students without TASK scores	-24	
3.	Total number of students in Group One selection pool		116
4.	Number of students who withdrew after fourth week of instruction		10
5.	Drop rate	10 dropped out 116 total enrollment for an 8% dropout rate	

Group Two

Names taken from NSO attendance rosters.

1.	Number of students randomly selected from NSO rosters		146
2.	Number of students with no TASK scores	-17	
3.	Number of remaining students who had incomplete records, dropped out before the fourth week or were enrolled in College Success	-25	
4.	Total number of students in Group Two selection pool		104
5.	Number of these students who withdrew after the fourth week of instruction		19
6.	Drop rate	19 dropped out 104 total enrollment for 18% dropout rate	

In reviewing data about this group, some additional observations can be made. It is likely that Group Two (NSO) students may have positive qualities not found in the general student population. An unpublished study by Kovak (1980) seems to support the notion that those who attend NSO are likely to earn a superior academic record of performance. The findings of this study also reveals that (NSO) students consistantly out performed Group Three (IS) students. Although these differences were directional in nature, and were not statistically significant, it does support the notion that (NSO) students do perform better by earning a higher grade point average and completing more units of college credit.

Another point regarding these two groups needs to be made. In Group One (CS) and Group Two (NSO) the performance of one self-selected group is compared to that of a second self-selected group. Because both groups are self-selected and the motivation for self-selection is similar, it is theorized that to some extent any differences between these two groups that were related to self-selection were neutralized.

Group Three

Names taken from IS attendance rosters.

1.	Number of students who attended the two information sessions		142
2.	Number of students without TASK scores	-37	
3.	Number of remaining students who had incomplete records, dropped out before the fourth week or were enrolled in College Success	-21	
4.	Total number of students in Group Three selection pool		84
5.	Number of students who withdrew after the fourth week of instruction		18
6.	Drop rate	18 dropped out 84 total enrollment for 21% dropout rate	

Group Four

Names taken from the Dean's listing of first-time students who registered in class during the first two weeks of class.

1.	Number of first time students who officially enrolled during the first two weeks of the semester		75
2.	Number of students without TASK scores	-49	
3.	Number of students who had incompleted records or dropped out before the fourth week	-13	
4.	Total number of students in Group Four selection pool		13
5.	Number of students who withdrew after fourth week	-5	
6.	Drop rate	5 dropped out 13 total enrollment or 38% dropout rate	

This population was dropped from the study because of insufficient numbers.

EXHIBIT B

STATISTICAL FORMULAS

Data Analysis

The statistical analysis involved a group-to-group comparison of each of the following:

(1) Units of college credit earned

(2) Grade point average

(3) Drop-out rate

To accomplish these comparisons, the following statistical formulas were used:

$\bar{x}$ = sample mean of CS

$\bar{y}$ = sample mean taken separately from NSO and IS

α = 5%

cz = 1.65

1. Comparison of grade point average:

N = 37

$$Z = \frac{\bar{x} - \bar{y}}{\sqrt{\frac{s_x^2}{37} + \frac{s_y^2}{37}}}$$

2. Comparison of number of units of college credit earned:

N = 37

$$Z = \frac{\bar{x} - \bar{y}}{\sqrt{\frac{s_x^2}{37} + \frac{s_y^2}{37}}}$$

3. Comparison of the college drop-out rates:

p_1^* is a sample proportion from CS.

p_2^* and p_3^* are sample proportions from NSO and IS respectively.

α = 5% cz = -1.65

$$Z = \frac{p_1^* - p_2^*}{\sqrt{p^*(1 - p^*)}\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$$

$$p^* = \frac{x + y}{n_1 + n_2} \quad \text{(pooled estimate for } \sigma_{p_1^* - p_2^*})$$

The Results

CS students out-performed each of the other two groups on all measures of academic performance and persistance, as shown in the following displays. Based on the data from these sample groups, the observed differences in each comparison involving CS were significant at the 5% level.

Although NSO students consistantly out-performed IS students, these differences were not significant at the 5% level.

A Graphic Illustration Comparing the Mean Grade Point Averages of the Three Groups

The following symbols will be used:

μ_1 - the mean grade point average of CS

μ_2 - the mean grade point average of NSO

μ_3 - the mean grade point average of IS

n - the number of trials compared, and for the given data n = 37

Comparing CS and NSO

$\bar{x}_1 = 2.5643$
$\bar{x}_2 = 2.0682$ $\Big\rangle$ $\bar{x}_1 - \bar{x}_2 = 0.4961$ converts to a z-score = 1.82

Thus $\mu_1 - \mu_2 > 0$ at the 5% level of significance.

Comparing CS and IS

$\bar{x}_1 = 2.5643$
$\bar{x}_3 = 1.6411$ $\Big\rangle$ $\bar{x}_1 - \bar{x}_2 = 0.9232$ converts to a z-score = 3.44

Thus $\mu_1 - \mu_3 > 0$ at the 5% level of significance.

Comparing NSO and IS

$\bar{x}_2 = 2.0682$
$\bar{x}_3 = 1.6411$ $\Big\rangle$ $\bar{x}_2 - \bar{x}_3 = 0.4271$ converts to a z-score = 1.47

Thus $\mu_2 - \mu_3 > 0$ cannot be rejected at the 5% level of significance.

A Graphic Illustration Comparing the Mean Numbers of Units Completed By the Three Groups

The following symbols will be used:

μ_1 - the mean number of units completed by CS

μ_2 - the mean number of units completed by NSO

μ_3 - the mean number of units completed by IS

n - the number of trials compared, and for the given data n = 37

Comparing CS and NSO

$\bar{x}_1 = 9.1486$
$\bar{x}_2 = 6.5136$

$\bar{x}_1 - \bar{x}_2 = 2.6350$ converts to a z-score = 2.32

Thus $\mu_1 - \mu_2 > 0$ at the 5% level of significance.

Comparing CS and IS

$\bar{x}_1 = 9.1486$
$\bar{x}_3 = 6.2703$

$\bar{x}_1 - \bar{x}_3 = 2.8783$ converts to a z-score = 2.53

Thus $\mu_1 - \mu_3 > 0$ at the 5% level of significance.

Comparing NSO and IS

$\bar{x}_2 = 6.5136$
$\bar{x}_3 = 6.2703$

$\bar{x}_2 - \bar{x}_3 = 0.2433$ converts to a z-score = 1.48

Thus $\mu_2 - \mu_3 = 0$ cannot be rejected at the 5% level of significance.

A Graphic Illustration Comparing the Percent Drop Rates For the Three Groups

The following symbols will be used:

π_1 - the proportion of CS students that dropped out of college

π_2 - the proportion of NSO students that dropped out of college

π_3 - the proportion of IS students that dropped out of college

n - the number of students in the samples, and for the given data n = 304

Comparing CS and NSO

$p_1^* = 8\%$
$p_2^* = 18\%$ > $p_1^* - p_2^* = -10\%$ converts to a z-score = -2.11

Thus $\pi_1 - \pi_2 < 0$ at the 5% level of significance.

Comparing CS and IS

$p_1^* = 8\%$
$p_3^* = 21\%$ > $p_1^* - p_3^* = -13\%$ converts to a z-score = -2.97

Thus $\pi_1 - \pi_3 < 0$ at the 5% level of significance.

Comparing NSO and IS

$p_2^* = 18\%$
$p_3^* = 21\%$ > $p_2^* - p_3^* = -3\%$ converts to a z-score = -0.05

Thus $\pi_2 - \pi_3 = 0$ cannot be rejected at the 5% level of significance.

Conclusion

Using the given data, there is sufficient evidence at the 5% level to conclude that College Success does result in significant positive differences in the academic performance and persistance of matched groups of students. No statistically significant differences between the other two groups of students was observed on any of the measures of academic performance or persistance.

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